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April 2, 1897

Astronomical Doctrines

Presented

IN NEW ASPECTS.

BY

PH. AUG. ALBRECHT,

BALTIMORE, MD.

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"Attempt the end, and never stand to doubt;
Nothing's so hard, but search will find it out."

—Robt. Herrick.

„Was kein Verſtand der Verſtändigen ſieht,
Das übet in Einfalt ein kindlich Gemüth."

Schiller.

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Astronomical Doctrines.

PRESENTED IN NEW ASPECTS, BY PH. AUG. ALBRECHT.

Prevailing scientific ideas of any period are regarded by the mass of the people, not by learned professors alone, as established facts. Scores of scientific men in the past propounded many odd doctrines before acknowledged facts harmonized with theories.

It is astonishing how the path of investigation is cleared, when we come to a comprehensible conclusion regarding the subject under examination. And what induces this investigation? The answer is skepticism.

Just as lightning has a tendency to clear the terrestrial atmosphere, skepticism is charged with the task of brushing the cobwebs from the human intellect.

T. A. Buckley in his introduction to Pope's translation of Homer's Odyssey says: — "Skepticism is as much the result of knowledge, as knowledge is of skepticism. To be content with what we at present know, is for the most part to shut our ears against conviction; we must set aside old notions and embrace fresh ones, and as we learn, we must be daily unlearning something and emancipate ourselves from knowledge previously acquired."

In Sir John Herschel's Treatise on Astronomy we read:— "At this day there is not a single perturbation, great or small, which observation has ever detected, which has not been traced up to its origin in the mutual gravitation of the parts of our system and been minutely accounted for in its numerical amount and value by strict calculations on Newton's principles.

It is the triumph of physical Astronomy to have rendered a complete account of them all and to have left nothing unexplained, either in the motions of the Sun or in those of any other of the bodies of our system." This was written half a century ago.

He also writes: — "The reader will take care not to confound the variation of the position of the earth's axis in space with a mere shifting of the imaginary line, about which it revolves in its interior. The whole earth participates in this movement and goes along with the axis as if it were really a bar of iron driven through it.

That such is the case is proved by the two great facts: — First, that the latitudes of places on the earth, or their geographical situation with respect to the poles, have undergone no perceptible change from the earliest ages. Secondly, that the sea maintains its level, which could not be the case if the motion of the axis were not accompanied with a motion of the whole mass of the earth."

As a matter of course other works on Astronomy contain similar explanations in regard to the stability of the earth's axis.

But now we are suddenly surprised with the startling news, that the axis of old mother earth is somewhat loose, in fact that the North pole is wabbling slightly. The annual movement is said to be only 4 feet. Investigations by Prof. Chandler, of Harvard University, have developed the fact that the axis of the earth revolves in a circle, having a diameter of 30 feet, and that the time of revolution around the circle is 427 days. The consequence of this curious phenomenon is a slight change in the geographical position or latitude of places on the earth.

It appears that almost simultaneously with Prof. Chandler, this fact was also discovered in 1889 at the observatories at Berlin, Potsdam, Prague and Strassburg. To further investigate this remarkable circumstance an expedition was sent to Honolulu, where the surmised changes in latitude found confirmation.

At the Fall meeting 1896 of the National Academy of Sciences at New York, Prof. Simon Newcomb spoke of the physical causes of the periodic variations of latitude.

Apropos, it is interesting to note here, that forty-five years previously the celebrated Astronomer Bessel at Koenigsberg appears to have suspected something to the above effect. In a letter to Gauss, the eminent director of the observatory at Göttingen, the celebrated Humboldt wrote in 1846, after the death of Bessel: — "With Bessel's death a queer conviction of his was carried to the grave with him, as is evident from an autograph letter dated June 1st, 1844. Bessel's words were: I inform you of something which is as yet immature. I entertain a suspicion against the invariability of Polar distances. My observations with our new Meridian Circle, which agree very nicely with one another, are constantly reducing the Polar distance of Koenigsberg, since the Spring of 1842 to the present time but three-tenths seconds, but even this trifle seems to me cannot be an error of observation, as in accordance with my present mode of observation everything is eliminated that might influence the observations in any way. I surmise as a cause changes in the interior of the earth, which influence the direction of gravitation."

Strange that this queer conviction, as Humboldt styles it, should have rested for forty-five years in its grave before it became resuscitated, and that none of the great mathematicians and astronomers, contemporaries with Bessel, should have taken up and pursued the discovery made by him.

Humboldt, in his Cosmos, mentions various views adopted by celebrated physicists regarding the nature of the interior of the earth. He also says: "Venturesome and arbitrary conjectures have given rise to still more fantastic notions, of course, in wholly unscientific circles." To mention one:

Near the North pole, at latitude 82 degrees, whence the Polar light emanates, is an enormous opening through which a descent might be made into the hollow sphere. Humboldt says: "Sir Humphrey Davy and myself were even publicly and frequently invited by Captain Symmes to enter upon this subterranean expedition." Even the celebrated Halley, at the end of the seventeenth century, hollowed out the earth in his magnetic speculations.

About twenty years ago, (see May No. 1876, Pop. Science Monthly), Judge Chas. P. Daly, in his presidential address before the New York Geographical Society, also alluded to the before mentioned Captain J. C. Symmes, an officer of the regular army of the United States, who about the year 1819 advanced a theory, to the propagation of which he devoted the remainder of his life, that the earth was hollow, was inhabited within, and had an opening at the pole, which became known throughout the country as "Symmes's Hole." He pressed the subject upon Congress, urged an expedition to the pole to test his theory, and a Russian gentleman is said to have offered to fit one out if Symmes would conduct it under the auspices of Russia, which the Captain declined on the ground that the honor of establishing the theory should belong to the United States. He went over the country delivering lectures in support of this theory, in which he firmly believed to the day of his death. His son, now an old man, has revived it, and is advocating it, as his father did, by delivering public lectures. The father's theory was, that this hole or opening in the Arctic was about one thousand miles in diameter, and somewhat wider at the Antarctic; and now that we have reached within five hundred miles of the Arctic pole, about half of the assumed diameter of the supposed hole, without any indication so far of its existence, the son believed that if Captain Hall, of the Polaris expedition, had gotten several degrees farther north, he would have found evidence of the truth of the theory. "Captain Hall startled us at the reception given to him and his officers by this society, before the departure of the Polaris, by announcing publicly to us his belief in the existence of this hole, and of his determination to

go in pursuit of it; a belief which, being an uneducated man, and but little acquainted with the geography of the Arctic, was firmly fixed in his mind."

In a letter put forth last February, by Mr. Symmes, he not only argues that the earth is hollow, but that it has as much inhabitable surface within as without. He imagines that the inside is inhabited by human beings, who are the progenitors of the white race, now upon the outer surface, and that there are apertures at the poles four or more hundred miles in diameter. This recalls the belief as to the cause of the earth's motion, in the middle ages, when it became apparent from the researches of Copernicus and Galileo that it revolved upon its axis, which accounted for the motion, by supposing that the interior of the earth was hollow and was the place to which the damned were condemned, who produced the motion by their continual attempts to climb up the inside of this hollow ball in their fruitless efforts to get out."

Other scientific and unscientific Zetetics have attempted to prove the earth to be flat, but with signal failure. Now the latest in this line of investigation is according to the following extract from the New York Journal of Dec. 27, 1896: "That there are some who think the earth is hollow, viz: An expedition of scientists is about to leave Chicago and take up its position on the Gulf coast, near Estora, Florida, for the purpose of demonstrating that the earth, instead of being convex, is concave, and that as a matter of fact we live on the inside and not on the outside of it.

This is termed the Koreshan theory."

From the aforegoing statements, and others to follow, it will become apparent, notwithstanding the quotations from Sir John Herschel's work to the contrary, that there are yet problems in Astronomy which admit of solutions other than such as have been accepted by the scientific world as irrevocable.

Sir David Brewster, in his account of Kepler's method of investigating truth, (Martyrs of Science) says: "The influence of imagination as an instrument of research has been much overlooked by those who have ventured to give laws to philosophy. This faculty is of greatest value in physical inquiries, etc."

Wm. W. Payne, in Popular Astronomy, August 1896, says: "The resources of Astronomy for this purpose are evidently exhaustless."

Well, in conformity with Dr. Brewster's suggestion, we have been wearing our thinking cap for a while and exercised our imagination.

It is now our purpose to present in the following lines some ideas and conclusions which this process of reasoning revealed to us.

We will begin with

Motion,

superinduced by electro-magnetism, the inherent quality of all cosmical bodies, is synonymous with Universal Gravitation. It is the exponent of that great Primordial Force which rules the Universe and has for its realm infinite space, with all the cosmical bodies or matter which occupy its bewildering depths.

Aristotle the Stagirite considered: "All changes in the physical world may be reduced to motion."

That the Solar System has a progressive motion, no one acquainted with the subject will be apt to deny, and this very translatory motion of the Sun is the *true cause* of the

ELLIPTICAL MOTION

of planets around the Sun.

When Copernicus in 1542, after more than thirty years of study, presented to the civilized inhabitants of the world his revived doctrine of the ancient Pythagorean system of the world, an immense improvement over the fanciful system of epicycles, which was in vogue until then, was attained. Copernicus' circular orbits of the planets would not, however, tally with the real movements of the planets and the moon, in accordance with observations.

It was reserved for the illustrious Kepler, a century later, to supply the deficiency.

He was enabled to utilize observations made and recorded by Tycho de Brahe of the planet Mars.

From calculations based on these observations, his extraordinary genius led him to deduce his first two laws of motion in the Solar system. The first law reads:

"Each planet moves around the sun in an ellipse, having the sun at one of its foci."

The second law is:

"The radius vector of each planet describes equal areas in equal times."

These two laws are true for each planet moving in its own ellipse about the sun.

Sir John Herschel says: "Geometers have agreed in each single revolution, or for any moderate interval of time, to regard the motion of each planet as elliptic and performed according to Kepler's laws, with a reserve in favor of certain very small and transient fluctuations, but at the same time to regard all the elements of each ellipse as in a continual, though extremely slow state of change."

Herschel and other astronomers say: "Were there no other bodies in the universe but the sun and one planet, the

latter would describe an exact ellipse about the former and continue to perform its revolutions in one and the same orbit forever."

If the sun revolved on his axis alone without the accompanying translatory motion through space, (in this sense and no other could Herschel have written the above remark), as astronomers appear to have taken no account of the sun's proper motion in space in their reckonings heretofore, *that* one planet would perform its journey about the sun in a purely circular orbit.

No result can take place without a cause.

Now, up to the present time there seems to be no work on astronomy containing any explanation as to the *real* cause of the elliptic motions of planets.

After Kepler showed, through the medium of his laws, what observations had proven, that planets move around the circumference of an ellipse, the question presented itself: What law of force will compel a planet to describe an ellipse around the sun, having the latter in one of its foci?

According to Newcomb and Holden such problems could not be solved by mathematicians before the time of Newton, who by his course of reasoning demonstrated that the motions of celestial bodies could be accounted for by the force of Universal Gravitation.

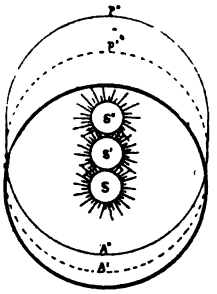
Humboldt mentions Bessel as having investigated in 1824 that portion of planetary disturbances due to the sun's motion, but it appears without obtaining any practical result, it being extremely difficult in investigations of this nature to separate the absolute from the relative motion.

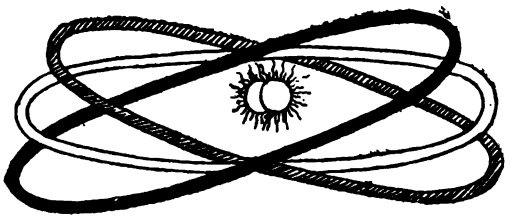
Prof. Simon Newcomb, of Washington, spoke at the autumn meeting 1896 of the National Academy of Sciences at New York of the Solar motion as a gauge of Stellar distances.

Notwithstanding all that, it seems remarkably strange that astronomers in general should have paid so little attention to the proper motion of the sun, in not taking into account nor considering this motion as an important factor in determining the causes of planetary perturbations. Had Kepler or Newton reckoned with this circumstance, they would probably have experienced considerable less difficulty in the formulation of their respective laws.

We contend, therefore, that the sun's proper motion is the primary cause of the Elliptical Orbits of the planets, and it certainly does not require more than ordinary reasoning nor much imagination to perceive at once, that the forward movement of the sun in his path must produce a corresponding effect on the orbital motion of his planetary retinue, and which must undoubtedly result in a change of the form of the planetary orbit, producing an elongation of the same. To

further explain, let us assume the circular orbit of Copernicus, with the sun stationary in its center. The planet moves around the circumference of the circle, there is as yet no peri-, nor an aphelion; but now the sun starts to move in a certain direction, as a consequence the outline of the circle is disturbed, the planet cannot adhere to its former path, it must follow the direction of the sun, and in so doing it describes a new orbit at each revolution, which, as a natural consequence, must now assume the elliptic form. It is plain, therefore, that as the planet cannot sweep around the sun in a circular orbit, it will be nearer to that body, when it arrives in that part of its new orbit, which is in advance of the sun, and will here find its perihelion point, whereas in rounding the sun, both he and the planet will be travelling in opposite directions, the latter, after reaching the limit allowed by the sun's attractive power or centripetal force, will have gained its aphelion, and now returns towards perihelion, and in arriving there, the planet must describe an orbit in advance of the previous one, and on nearing its aphelion again it will not travel quite so far as before; thus in one part of its orbit the planet advances upon and in the other it recedes from the one travelled before, and so on continually.





These figures, although entirely out of proper proportion, will assist in explaining the above subject and also the next one following.

Owing to the immense distance of the fixed stars, this variation in the orbital motion of the earth is ordinarily imperceptible and becomes manifest only after the lapse of many ages.

Humboldt says in Cosmos: "The observer who earnestly pursues the path of knowledge, is led from one class of phenomena to another by means of the mutual dependence and connection existing between them."

In verification of the above observation, we are involuntarily guided to suggest another solution to what was at one time an astronomical enigma, which greatly perplexed astronomers from the time of Hipparchus, two thousand years ago, who first discovered the

Precession of the Equinoxes.

Its cause remained a mystery, until, as Sir John Herschel says, "The sagacity of Newton discovered this singular mode of action, which accordingly consists of the combined disturbing action of the sun and moon on the protuberant matter of the earth's equatorial region." Some astronomers state that there would be no precession if the earth were really spherical.

Now this is obviously a misconjecture, as we propose to demonstrate.

When Hipparchus entered upon his researches to determine the length of the year, he found a difference between the equinoctial, or Solar, and the sidereal year. The tropical year being the shorter, proves that the position of the equinoxes is retrograding or moving from East to West. Hipparchus also found that the change was in the equator, and not in the ecliptic, because the declinations of the stars changed, while their latitudes did not.

The amount of this westward motion of the equinoctial points is said to be about 50 seconds per year.

Burritt, in his Geography of the Heavens, states: "Of all the motions which are going forward in the Solar system, there is none which is more important to notice, more difficult to comprehend, or to explain, than what is called the Precession of the Equinoxes."

We will now proceed to offer our explanation, which embodies the solution of the enigma alluded to before; for this purpose we need only refer to the proper motion of the sun, and the consequent motion of the earth in her orbit, as described previously in elucidating the cause of elliptic orbits.

It is a well known fact that a planet in moving from Perihelion towards Aphelion is continually before its mean place, where it would be were its orbit a true circle, and in moving from the Aphelion to Perihelion, its mean place is before the true place.

It is plainly evident from the fact stated, that the earth, after passing her perihelion January 1st, is moving towards her aphelion, and that her true place is then before the mean place, which would and could not obtain if the sun had no forward motion in space. Thus the sun advances in his path, meeting the earth half way, to use a popular expression; the earth passes the sun in the opposite direction, arriving at her equinox sooner than the year before, and then repeats this at every subsequent revolution.

To compare this with terrestrial objects, let us suppose a large old-time ship be called "Helios," the sun, *sailing* up the Chesapeake Bay, a small tugboat named "Gæa," the earth, *steaming* towards the ship down the bay, passing the ship on

her larboard side; having a certain distance to go down the bay, the tug returns, passing the ship on the starboard side, and on arriving at her wharf, the tug is again sent down the bay, this time also passing the ship on her larboard side, but at a point further up the bay; whereas, if the ship had lain at anchor, the tugboat would have passed her at precisely the same place in the bay as on her first trip.

Each annual circuit under-laps the one before in the direction of the earth's perihelion, and no one returns into itself, forming peculiar spiral curves, none of which are in the same plane. These might be compared somewhat to the manner in which a ball of twine is wrapped. The sequence, therefore, must be a variation in the earth's orbit, which in a century is said to amount to about 48 seconds, and having a tendency to bring the ecliptic and the equator together, upon which subject we will treat hereafter.

To summarize then:

The sun in his forward motion meets the earth a little in advance every year, and the earth, on account of her apparently accelerated motion in moving toward her summer solstice or aphelion point, jointly have the effect of producing the so-called

PRECESSION OF THE EQUINOXES.

On the strength of the testimony presented above, no doubt should exist as to the verity of our assertion, and that we have succeeded in developing a clear and definite theory of the subject under consideration, thus arriving at a happy solution of this difficult problem. (See diagram on next page.)

PROPER MOTION OF THE SUN AND DIRECTION OF THE SOLAR APEX.

Sir John Herschel states: "No one who reflects with due attention on the subject, will be inclined to deny the high probability, nay certainty, that the sun has a proper motion in some direction, and the inevitable consequence of such a motion, unparticipated by the rest, must be a slow average apparent tendency of all the stars to the vanishing point of lines parallel to that direction, and to the region which he is leaving. This is the necessary effect of perspective."

Newcomb and Holden explain this very clearly, thus: "It is as if one were riding on the rear of a railway train and watching the rails over which it has just passed. As we recede from any point, the rails at that point seem to come nearer and nearer together."

E
D
C
B
A

Herschel again: "It is certain that this motion must be detected by such observations; but it seems to be the general opinion of astronomers, at present, 1833, that their science is not yet matured enough to afford data for any secure conclusions of this kind one way or the other." It was indeed supposed by Sir William Herschel, and also previously by Bradley in 1748, that such a common tendency could be made out and as a result that the sun and Solar system were moving towards a point in the constellation Hercules.

Notwithstanding the opinion of Sir John quoted above, the supposition of Sir William Herschel seems to be the prevailing idea at the present day; other astronomers having found, by a combination of the apparent motion of from 500 to 800 stars, approximating results for the direction of the sun's motion. An astronomer Royal of England is said to have remarked: "The matter is left in a most delightful state of uncertainty, and I shall be very glad if anyone can help us out of it."

A new calculation of the sun's motion in space was made some short time ago by an American astronomer, Mr. A. D. Risteen. Previous calculations have been founded on the observed apparent proper motions of stars, but Mr. Risteen's estimate is based on the motion of 42 stars in the line of sight, as spectroscopically determined by Dr. Vogel. The result reached is, that the sun is moving at the rate of about eleven miles a second, toward a point in the constellation Bootes.

It may not be amiss to mention here the success attained at the Alleghany Observatory in determining by measurement the velocity of rotation of Saturn's rings, by means of a spectroscope. Spectroscopic analysis affording the means to determine whether a star recedes or approaches, a very delicate and difficult task. In accordance with a certain optical principle, a line in the spectrum of a heavenly body is displaced toward the violet, if the body is approaching the earth, and toward the red if the body is receding.

We will now proceed and offer some of our views on the subject.

The sun's path, for ages past, has been confined to the ecliptic, which makes an angle with the equinoctial of about 23½ degrees, called the Obliquity of the ecliptic. This angle has been slowly decreasing at the rate of about 47 seconds in a century; this diminution, it is said, will not always continue, but will oscillate between the limits of 21 and 28 degrees.

In this table from Littrow the gradual diminution can be noted.

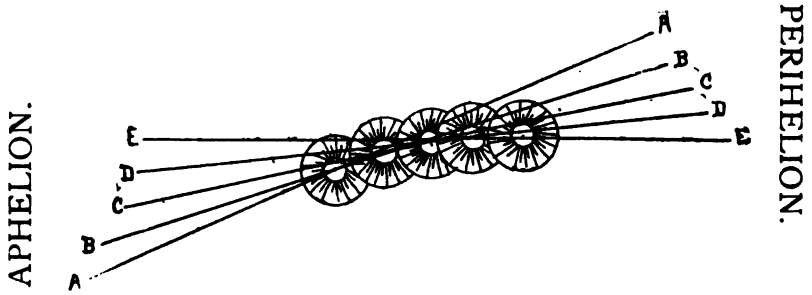
B. C.,	1100	23°	52′ 0″
"	350	23	49 20
A. D.,	1000	23°	34′ 26″
"	1280	23	32 2
"	1437	23	31 48
"	1750	23	28 18
"	1850	23	27 32
"	1893	23	27 12

The cause is attributed to the joint action of the sun and planets on the earth.

We entertain a different view, viz:

The earth at every revolution around the sun pursues a new path, differing from the previous one, thus: At aphelion the new orbit overlaps the former one, at perihelion it is on a lower level, but always advancing with the sun.

The figure here will tend to elucidate the idea more fully, and will also assist in comprehending, how the precession of the equinoxes occurs; see also the zodiacal figure on previous page.



Here we have the sun advanced from A to E, the major axis of the earth's orbit passing through the centre of the sun, at each revolution from A to E. Let A represent the obliquity of the ecliptic at the present time, at B, C and D it will continually diminish at a rate of about 46–48 seconds in a century until at E, the *obliquity will have completely vanished. The equator and the ecliptic will then coincide.*

Littrow applies the formula 0.48368 as the secular rate of diminution and gains as the result, that the advent of eternal spring will take place about the year 179300.

We will further explain the figure, at A, aphelion, the earth is in her summer solstice, she moves to A, perihelion, her winter solstice, then, after passing the equinox, returns in her orbit only to B, aphelion, then advances to B, perihelion, going beyond A, returning again she reaches her spring equinox somewhat in advance of the place where it occurred the previous year, causing precession of the equinoxes, all on account of the sun's proper motion, the earth then moves on to C, aphelion, then on again to C, perihelion, the point of the

new orbit in advance of B, and so on continually until the orbit E is reached, after which the *obliquity will again increase,* but in the *opposite* direction.

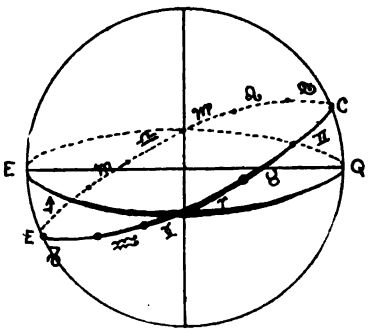
For further explanation we need the accompanying diagram, to which we now refer, and in so doing we must set aside altogether the primary ideas received from books on astronomy, endeavoring to view these questions independently of all preconceived opinions.

Before proceeding, however, it is essential that we endeavor to correct an erroneous view, presented in all books on astronomy, where the ecliptic is drawn as a plane, with the equator crossing it at the angle of 23½ degrees, the earth's axis inclined to the ecliptic by that amount. Now if we simply shift these two planes or tilt them over, so that the one takes the place of the other, we will have them in the right position, as they really should be.

The figure herewith presents the correct view.

In one sense the description given in books is not incorrect, only with the difference that the ecliptic is in reality the inclined plane up and down which the earth and the other planets travel.

The fact remains, the theory only is changed.



To illustrate, if we spin a top and place it on an inclined surface, say a board, the top will maintain its upright position, but of course its axis will be inclined to the plane of the board.

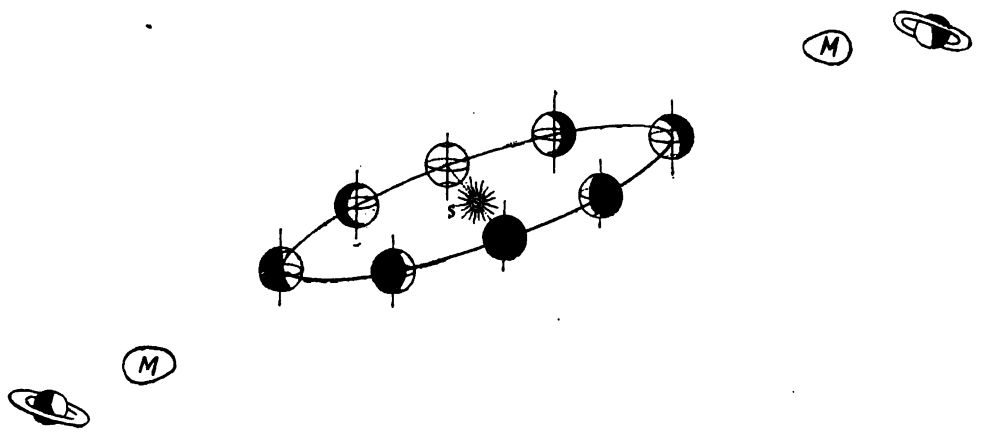
So it is with the earth; as depicted in books the earth moves in one part of her orbit as if she were leaning forward, in the other as if she were backing to the rear.

Now view this figure. (See diagram on next page.)

Here we have the sun and the ecliptic, with the earth representing the seasons; it will be seen that the earth occupies an upright attitude throughout her orbit, just as a person walks erect up and down a stairway, and it surely must be admitted by any unbiassed mind, that this tilting of the ecliptic places the earth in a natural, if not a more convenient position. The identical phenomena obtain, as in the former situation, we only change the terms of explanation; in place of saying:

When the North pole leans towards the sun, we have summer in the northern hemisphere, and when the South pole is turned toward the sun, the South has its summer; we now have to state: When the earth arrives at the summer solstice, the sun shines perpendicularly at places on the line of the Tropic of Cancer; the northern hemisphere now enjoys summer, while the sun not only illuminates the North pole, but the whole Arctic circle as well; when the earth reaches her winter solstice, her equator is elevated 23½ degrees above the equator of the sun, whose rays are now perpendicular at places on a line with the Tropic of Capricorn. At the equinoxes the description would not vary from the customary, the sun is vertical at the equator and the days and nights are everywhere equal.

As further evidence of the correctness of our theory, we present the winter and summer full moon in the figure.



As the full moon is always 180 degrees distant from the sun, it follows that the moon takes the place in summer which the sun occupied in winter, and vice versa. The moon's orbit is inclined to the ecliptic at an angle of about 5 degrees, the moon's high or low station may therefore be augmented by that amount.

Consequently the full moon is very low in the ecliptic in summer, as the earth is then below the sun's equator, on the contrary, in winter the full moon is high up, a line from the centre of the sun through the earth always striking the full moon.

The rings of Saturn offer other indisputable proof which cannot be ignored, when this planet is in his orbit as he was in June 1870, which being below the level of the earth in the ecliptic, the northern plane of the rings become visible to us; in 1885 the reverse took place, the planet then was in Cancer and high up in his orbit, we were therefore below his level and were enabled to see the south side of his rings in their

greatest expansion. (See figure). In 1899 the upper or north side of the rings will become visible again as in 1870.

We may at once explain right now, *why the moon always presents the same side to our view.*

In looking at a photograph of the moon through a stereoscope, (taken by Bierstadt Bros., New Bedford, Mass., from negatives by L. M. Rutherford), something bearing resemblance to a peeled orange, but *egg shaped*, surprises our view.

This then is prima facie evidence *that the moon is not a spherical but an elongated body, with the smaller end pointing towards the earth.*

As it is impossible for a body so shaped to turn on its axis, in the manner as applied to the planets, we must look upon the moon as being held by the earth, as a hand would grasp an Indian club, and swing it around, the heavier part of the moon which is always turned away from us, is tempted by centrifugal force to fly off into space, but is prevented by the earth's centripetal power, which holds her in place as if by a cord, and thus the moon swings around the earth, unable to get away.

The *oval shape of the moon is what causes* her slight rolling motions periodically up and down and sideways, termed her Librations. This feature of the moon was first ingeniously utilized by De la Rue for the production of stereoscopic views of the moon.

Hansen, who was one of the most prominent authorities on the theory of the moon, had already previously surmised that she might be an ellipsoid with the major axis directed towards the earth, it would seem, therefore, that such stereoscopic views are a verification of Hansen's conjecture.

Photographs of the moon were unknown in the days of Humboldt, if he had seen one through a stereoscope, he would in all probability not have written "the increased accumulation of matter on that half of the moon which is turned toward us determines the periods of rotation and revolution."

Now, then, to the diagram.

Here we are supposed to see the universe at large, unfathomable space to the limits of the milky way, this immense starry belt embraces all cosmical bodies, visible or not to the eye, with the aid of the most powerful telescopes, even comets, which are roaming about in distant realms and whose light has become too dim to show their whereabouts. The nebulous clusters situated apparently beyond and at right angles with the Via Lactea are not included, as these probably constitute entirely separate systems.

The immense aggregation of stars which encircles the Solar System represents a great celestial magnetic battery or electrical dynamo of immeasurable power, ordained by nature

to supply the world at large with force or power commensurate with the demands of Universal Gravitation.

When Shakespeare let Hamlet say: "There are more things in heaven and earth, Horatio, than are dreamt of in our philosophy," the advent of steam power, electricity, optical instruments, etc., was still concealed under the mantel of the future.

Humboldt pertinently asked in Cosmos, "Who will venture to affirm that we have discovered the whole number of forces which pervade the universe."

This was fifty years ago, what wonderful discoveries and inventions have since been brought to the light of day, only lately the perplexing Roentgen rays, miraculous things that were certainly not even dreamt of in Shakespeare's times.

The same conditions of attraction which exist between the sun and planets, also affect the star suns of the universe, inter se.

Dr. Henry Raymond Rogers said fifteen years ago, "All space being pure vacuum, distance is virtually annihilated, and all the spheres are brought relatively into close proximity. Mercury, 37 millions of miles from the sun, and Neptune, 2800 millions of miles away, stand alike in their relation with the great central orb."

It was Kepler, who, with a prophetic mind, conceived the true structure of our solar system, by announcing the future discovery of satellites about Saturn and Mars. The four of Jupiter had just been discovered by Galileo; also of planets between Mars and Jupiter, also between Venus and Mercury, and last, not least, the central position of the sun in the vast array of stars encircling the heavens like a belt.

Humboldt says: "Our planetary system lies in an eccentric direction, nearer to the region of the cross than to the diametrically opposite point Cassiopeia."

The sun's path, which is necessarily at the present time a mere matter of speculation, is shown in the figure to represent the sun in the position assigned to him by Kepler and others.

Celestial motions are in curves, and as these naturally extend over an immense space, the orbits will consequently appear, for an indefinite period, to be rectilinear, so that any deflection therefrom can only be observed after very long intermissions of time.

The sun's proper motion being directed by the force which emanates from the dominion of the laws of attraction where motion rules supreme, *the galaxy,* the sun's orbit must very probably assume a parallel course or be concentric with the outlines of the milky way, bearing in mind that this great luminous band extends six or seven degrees beyond what is indicated on astronomical maps.

The knowledge of this telescopic breadth of the milky way is due to Sir Wm. Herschel.

The sun's axis is assumed to be perpendicular to his orbit, and as it has been ascertained that the sun's equator is inclined to the ecliptic at an angle of 7°, 20′, the longitude of the ascending node being 80°, although, according to Littrow, astronomers are yet in doubt that the position of the sun's equator has been truly ascertained.

It must be noticed that both the winter and summer solstitial points touch the outlines of the milky way, the major axis of the ecliptic therefore lies apparently in the middle of the galaxy, separating that great circle into two nearly equal parts.

Now, as the celestial equator crosses the ecliptic at an angle of 23½ degrees, we have the position of the sun in space where it is now. But as it is conceded that the sun is moving in some direction, let us see whether we can determine that point in the heavens and his future orbit.

Let the larger circle on the diagram represent the sun's orbit. The oblique line portrays the Ecliptic and the horizontal line the Equinoctial. At the intersection of the two lines touching the larger circle, we place our sun, on each side on the line of the ecliptic extended, there is a figure of our earth, attended by the moon, one in her winter and the other in her summer solstice. Also Mars, Jupiter, Saturn and Uranus with their moons. Besides we see the Pleiades, the Hyades of Taurus, Orion's beautiful parallelogram, Sirius Procyon, the Twins and Capella; all of these combine to constitute this region, the most splendid of the heavens. The upper part of the diagram shows the Little Bear with Polaris, Cassiopeia, the Swan, etc. The milky way encircles nearly the whole of the figure. It will hardly be necessary to state, that this and the other illustrations contained in this article are not intended to be models of mathematical exactness, but merely as auxiliaries to assist the reader in comprehending the writer's ideas.

The next question to determine is, in what direction does the sun move?

As far as known, all planets revolve on their respective axis invariably from West to East, and their orbital motion is in the same direction. The sun has also an axial motion, revolving like the planets, from West to East, in about 25 days, the actual time not being known yet.

Now, as all bodies that revolve in a certain direction, also have a forward motion in the same line, this must be applicable to the sun as well, and as he revolves from West to East, his proper motion in space must also be the same way.

But now a difficulty arises. Which part of the firmament is East and which is West?

Ordinarily our right hand points to the East whilst facing

North, but as the whole firmament revolves about the pole, each constellation in the Zodiac is successively in the East, and the one diametrically opposite in the West. To arrive at the correct solution, we take the major axis of the ecliptic as a basis, and as this line is really the sun's path, we have only to reason out whether the sun is moving towards the winter or summer solstice. We know that the obliquity of the ecliptic is decreasing, and if we examine into the status carefully, we can come to only one conclusion, and that is, that the decrease can continue only in one direction, which is towards the winter solstice. In no other position can existing phenomena be made to agree with the Equator and Ecliptic, to which basis all motions in the Solar system must be referred.

If the sun moved in the opposite direction, toward the summer solstice, the Precession of the Equinoxes would take place in a manner reverse to the actual; also if he moved in any other direction, the obliquity of the Ecliptic would be on the increase, unless we moved the entire Solar system from the Ecliptic, and that is naturally entirely out of the question, as it has had its course ever since the most ancient observations of the stars have been placed on record, within the limits of that great circle.

Besides, we find the perihelion points of all the greater planets concentrated within the two quadrants from 1° to 180°, with the exception of Mars, who lags behind about 27°. As the milky way crosses obliquely from the northern to the southern heavens, the sun's orbit follows this plane, consequently the longitudes of the planets' perihelia are gradually on the increase, as evidenced by the following table.

	1801	1850	Increase.
Mercury . . .	74° 21′ 46″	75° 7′ 13″	—° 45′ 27″
Venus	128 43 53	129 27 14	— 43 21
Earth	99 30 5	100 21 21	— 51 16
Mars	332 23 56	333 17 53	— 53 57
Jupiter	11 8 34	11 54 58	— 46 24
Saturn	89 9 29	90 6 56	— 57 27
Uranus	167 31 16	168 16 45	— 45 29
Neptune . . .		49 9 13	

It is but reasonable to believe, that the sun must be moving toward that part of the heavens, where the perihelia of the planets are congregated, and in the plane of the Ecliptic.

If we consider the different velocities, the variations in the distances from the sun and the mutual attractions which the planets are subject to, the variations in the longitudes of their respective perihelia may possibly be accounted for after allowing for what is due to the Precession of the Equinoxes.

If this phenomenon was alone accountable for the increase in the longitude of the planets' perihelia, one would suppose

that they should all increase their longitude by about 50″ per annum, in proportion to each one's period of revolution about the sun.

But it will be perceived, that Saturn, Mars and Earth lead the van in the increase. Uranus, Jupiter and Mercury have about the same ratio, while Venus, who, with Uranus, occupies the most advanced posts, is actually restraining her perihelion's forward movement, as if to permit the others to gain upon her.

If we add the degrees of longitude of the perihelia of the seven planets, besides Mars, roughly together, we have about 624 degrees, and deduct for Mars 360 less 333=27 degrees, leaves 597 degrees; divide this sum by 8 and we have nearly 75 degrees as the average longitude of the greater planets' perihelion points, which corresponds almost exactly with that of Mercury.

Furthermore it would seem, that Mercury ought to be a sure guide to point out the direction of the sun's proper motion. The sun's equator and Mercury's orbit have both nearly the same inclination to the Ecliptic. The longitude of Mercury's perihelion is 75 degrees; the extraordinary eccentricity of his orbit is probably caused by the superior swiftness of his orbital motion; the smallness and close proximity of this planet to the central orb should classify it more as a satellite of the sun, whose mandate alone he must obey, without interference from the other planets whatever.

As an analogy we might refer to the giant planets and their satellites, which move nearly in the planes of the equators of their primaries.

Leverrier investigated the motion of Mercury, but found that the observed times of transit could not be reconciled with the calculated motion of Mercury. He found, however, that if, in addition to the changes of the orbit due to the attraction of the known planets, he supposed a motion of the perihelion amounting to 36 seconds in a century, the observations could all be satisfied. (Newcomb and Holden.)

Now very likely we have here the real power behind the throne again, viz: The sun's own proper motion, as the probable cause for which Leverrier searched in vain.

If the sun moved toward the summer solstice, the perihelia of the greater planets would be found in that direction, and especially Mercury's, whose orbital eccentricity is greatest of all. We may therefore safely conclude, that the sun's proper motion is directed towards the winter solstice, with a tendency to increase its longitude. If the sun were moving towards Hercules, the Ecliptic must have long since been displaced, and the above stated facts could not obtain. Besides this, in viewing the heavens we find a greater number of

conspicuous stars in the direction of the winter solstice, than diametrically opposite or towards Hercules, which therefore, contrary to accepted theories on this subject, is really the vanishing point from which the sun is receding, and where the stars have a tendency to approach together.

As a further verification of the direction of the proper motion of the sun in space, as given heretofore, we cite the late discovery by Prof. Schaeberle, at the Lick Observatory, of a faint companion to Procyon, the existence of which had many years ago been asserted by Bessel at Koenigsberg, who has already been mentioned in this article as the original discoverer of the variability of polar distances. Bessel's hypothesis, that Sirius and Procyon are each accompanied by an invisible or opaque companion, thus forming separate Binary systems, was brilliantly verified, first in 1862 by Clark's discovery of the companion to Sirius, and now by Prof. Schaeberle's finding of Procyon's acolyte. These faint stars must have been in existence in 1820, when Bessel first began his investigations, caused by the observed irregular motions of Sirius and Procyon. It was therefore over forty years before the Sirius companion was found, and seventy-six years before the other one was discovered. We must therefore either assume that these formerly invisible stars are gaining in luminosity, or that they have become visible to us by reason of the Solar system moving in their direction, thus bringing them within range of vision, as a mariner's light gradually looms up before our view and a ship approaches nearer and nearer to the beacon.

Having, we trust, pointed out the true direction of the sun's motion in space in a general way, we now turn to the sun, or rather the Solar system, referring to the diagram, at the summit of his orbit, where he will then move for a long time parallel with the present celestial equator; the earth, the moon, and in fact all planets and satellites, will then travel in the plane of the sun's equator, the earth's axis will be perpendicular to its orbit and eternal Spring will reign for ages to come; as before stated, this will occur in about 177000 years from now.

Next we have the sun advanced in his orbit, with the earth circling around him at an angle of 45 degrees, which is now the obliquity of the Ecliptic. It will be observed, that the inner circle is explanatory of the outer one, which constitutes the sun's vast orbit, with the earth following through all stages and encircling him right and left, up and down and down and up, so that if the earth's orbits were materialized, the sun would, in one revolution around his orbit, become completely enwrapped by the earth's orbits, like a ball of twine.

The figure will show that the earth, in passing from 0 to 45° obliquity, began the increase, by rotating around the sun from north-west to south-east, whereas she is at the present time decreasing the obliquity by revolving from south-west to north-east, beginning at the Vernal equinox. The wrapping of a ball of twine illustrates this orbital motion very clearly.

The next figure shows us the sun advanced in his orbit to where the earth's obliquity will amount to 90 degrees.

Twenty years ago Mr. Thos. Belt, in discussing the climate of the Glacial Period, (see Popular Science Monthly, Jan. 1875,) expressed his opinion, that the cold of the Glacial Epoch was caused neither by elevation of the land in high latitudes, nor by the position of the earth, due to the eccentricity of its orbit, as suggested by Lyell, Croll and others; but rather by great obliquity of the Ecliptic. If the axis of our globe be as that of Jupiter, the days and nights would be twelve hours each and there would be no succession of seasons. — With beginning of obliquity of the sun's path, seasons of heat and cold would succeed each other, and these would become respectively lengthened and intensified as the obliquity increased, etc.

When the Tropics overlap the polar circle, we will have a climate favorable to give us the glaciers as they existed in the ice age.

The cause of change in the sun's path he finds in changes in the distribution of the matter of the earth, altering the poles of rotation and the sun's path.

Strange that he, id est, Mr. Belt, also did not take the sun's proper motion into account.

That the earth has been subjected to many climatic changes, is too well known, also that a luxuriant forest covered not only Greenland, but spread over the Arctic lands.

It is only where internal changes would not satisfactorily account for geological and other phenomena, that a shifting of the earth's axis, or, according to Prof. Croll, variations in the eccentricity of the earth's orbit are resorted to. That Prof. Croll's theory does not contain the proper stamina, is proven by the fact, that not withstanding that the earth is nearer to the sun from *September* to *March*, in Winter, with the South pole exposed to the sun's rays, yet the Antarctic Continent is blocked by a barrier of ice to within 10 degrees of the limit reached in Arctic regions. This is due to the greater amount of land in the northern hemisphere over that in the southern; the thermal effect of the sun on land being greater than that on water.

Prof. J. S. Newberry, of Columbia College, in an article on the causes of the cold of the Ice Period, concludes his review by remarking: "That the facts already gathered seem

to be incompatible with any theory yet advanced, which makes the Ice Period simply a series of telluric phenomena, and so far strengthens the arguments of those who look to extraneous and cosmical causes for the origin of these phenomena." (Popular Science Monthly, July 1876.)

Now again we advance the sun to a point in his orbit, where the obliquity will be reduced to 23½ degrees; from the last point, 90 degrees, the earth's rotation about the sun will have been retrograde, that is, in reverse order than our earth is encircling the sun annually now, as the figures will show.

The next figure brings us again to Mr. Belt's twelve hours a day and twelve hours a night system, and so on, until, after going through another 90 degrees obliquity, we gradually come back to where we now are, and changing from retrograde to direct motion again.

We will now produce some further evidence in support of this hypothesis.

It seems that the variations which distinguish the larger planets from another, their respective distances from the sun, different degrees of density, size, etc., are causes to which may be attributed the varying inclinations of their axis to the Ecliptic.

Classifying them into pairs, we find the orbits of Mercury and Venus to have the greatest inclination to the Ecliptic, next Earth and Mars have nearly the same time of axial rotation, then Jupiter and Saturn, the giant pair, have both a very rapid rate of rotation, besides being accompanied by a greater number of moons, the earth's one, the two of Mars and Jupiter's five just equalling the number surrounding Saturn, not to forget Saturn's wonderful ring system.

The next, and as far as known, the last pair, Uranus and Neptune, is especially remarkable on account of the retrograde motion of their satellites.

It would appear as if Uranus' system is a counterpart of Jupiter's, with the latter tilted over 90 degrees, causing the moons of Uranus to revolve about him in a kind of Ferris Wheel style. Whereas all known satellites, with the single exception of Neptune's, move around their primaries in established planes, Neptune's moon presents a singular anomaly in the fact, that its orbit is shifting in one and the same direction, thereby increasing its inclination to the orbit of Neptune, since 1852 more than 5 degrees.

Now, as theories cannot be established unless observations exist to verify such theories, speculation may occasionally lead to hypothesis which conform to observed phenomena.

To many it may appear absurd and a product of unrestrained imagination, to assert that our own moon has before

and will again in time to come act in a manner similar to the satellite of Neptune.

The diagram shows where the earth skips around the sun, her axis parallel with the plane of her orbit or her equator, at right angles with the same. In this position the North and South poles of the earth have the sun alternately in their respective zenith. The earth then begins to decrease the obliquity of her Ecliptic, which here amounts to 90 degrees, while her motion itself in her orbit will be retrograde, until after 1½ million years it will again become direct, as at present.

The moon, in following the earth in her various gyrations about the sun, will be compelled to vary her orbit in accordance with the earth's variable obliquity of the Ecliptic, crossing the earth's poles, her equator and all intermediate zones; her monthly revolution will sometimes be direct, at others retrograde.

Thus the moon's orbit will then combine the aspect of what we now observe in the orbits of the satellites of Uranus and Neptune at the present time, remembering that the time of the earth's revolution is 1 year, that of Uranus 84 and Neptune's 165 years.

The relative position of the axis of the planets whose planes of rotation have been determined,—Mercury's and Venus' are unknown,—offer some very peculiar contrasts; thus Jupiter's is nearly perpendicular to his own, Uranus' is nearly parallel to his, as inferred from the motion of his moons, and Saturn's, placed between the two, nearly coincides with those of the Earth and Mars. The unique action of Neptune's satellite may possibly be due to the immense distance from the sun, preventing him from exercising his full power in his presumably most distant realm; or rather Neptune's axis of rotation is changing its inclination to his orbit, and his satellite is simply the indicator of this change.

We see then in the various modes of rotation of the planets, the different phases delineated, or an illustration of the changeable positions which the earth will again assume during the next complete revolution of the sun in his orbit, which at the rate of 46 seconds in a century will consume about 2,800,000 years.

The earth with the sun must then have completed this circuit about three times while the celebrated Fallen Column at Luray Caves, in Virginia, was in process of formation, if the calculations of Savans in reference thereto are correct.

As it is really impossible to conceive numerically the untold millions of stars which form the milky way, an analogous comparison with something terrestrial may facilitate the comprehensibleness of the subject.

As before stated, the milky way is the source of the

energy or power which rules the Universe, under the appellation of Universal Gravitation.

Now, as a comparison, let us imagine an amphitheatre, say, for instance, the Colosseum at Rome, crowded with spectators; these then would represent the stars composing the milky way, their admission-fee would constitute the power which keeps the performance in the arena in motion; the arena itself would represent the plane of the Ecliptic. The sun's representative would be the director or ringmaster in the middle of the circus, the performing horses, running around the circle or ring, equivalent to the Ecliptic, would represent the planets, and the riders their satellites, whilst the clowns might be supposed to sustain the character of comets, by reason of their apparently eccentric actions.

Asteroids.

The numerous minor planets differ considerably from the greater ones. They perform their orbital revolutions in periods from 1,200 to 2,300 days, as far as known, their orbits are more eccentric, they have a much greater inclination to the Ecliptic, and some of their orbits not only cross each other, but are actually so entangled, that if they were material rings, they could not be shaken apart. Their origin is still considered a mystery, and notwithstanding that Dr. Olber's hypothesis of a planet between Mars and Jupiter, having been shattered into these fragments by a mighty explosion, is still discredited by astronomers, we contend that Dr. Olber's theory is after all the most plausible one that can be projected as to their origin.

In 1833, when only four of these bodies were known, Sir John Herschel wrote on this subject: "It has been conjectured that the ultra zodiacal planets are fragments of some greater planet, which formerly circulated in that interval, but has been blown to atoms by an explosion, and that more such fragments exist and may be hereafter discovered. This may serve as a specimen of the dreams in which astronomers, like other speculators, occasionally and harmlessly indulge."

Ceres Juno Pallas and Vesta were discovered from 1801 to 1807. If Sir John Herschel had lived to witness the multitudinous discovery of bodies of this group since 1845, when the fifth one was found, making the number about 400 to the present time, the new process of photographing the heavens revealing new ones continually, we are rather inclined to believe that Sir John Herschel would have modified his above quoted remarks to some extent.

Have we not in our earth analogous phenomena? The terrible earthquakes, which have sometimes rent the surface

of the earth asunder and shaken entire continents? Were it not for the volcanoes, which act as a kind of safety valve to the pent up forces in the interior of the earth, fragments of our globe might be flying around the sun in like manner as the asteroids, some of the minuter ones getting trapped by the attraction of Venus and Mars.

Furthermore, have we not the evidence in the fall of the meteorites? What are they but remnants of the exploded planet, roaming about in space, like the fabulous Ahasuerus, the wandering Jew, until they find a resting place on some other planet, or the sun. Moreover, the presence of fossil organisms in meteorites, discovered by Dr. O. Hahn, proves them to be fragments of a larger body. Mr. Charles Darwin, after peering through the microscope on one of Dr. Hahn's specimens, is said to have exclaimed: "Almighty God, what a wonderful discovery."

Prof. Woehler, who was the first to detect organic substances in meteorites, found traces of Carbon and Hydrogen in a meteorite which fell in 1857 in Hungary, also from another, which fell in South Africa, he obtained a small quantity of organic matter proper.

"This circumstance supports strongly the view, that meteorites have not been formed independently, but that they have been part of a larger body, on which processes, similar to those obtained on our planet, have been going on." As Prof. F. Mohr wrote in „Geſchichte der Erde," 30 years ago. Also in Liebig's „Annalen der Chemie," as quoted in July 1876, Popular Science Monthly.

Is not all this convincing proof of Dr. Olber's hypothesis being entitled to recognition?

In connection herewith another very interesting fact presents itself in the peculiar action of Encke's comet, the one having the shortest period of revolution, only 3⅓ years, and the greatest eccentricity of the orbits of all the short period or Jupiter family of comets. *The so-called resisting medium* in space, which is supposed to be densest near the sun and affects the orbit of the comet by gradually shortening its period, *is possibly the Zodiacal light materialized.*

Although it is stated that the comet is reducing its mean rate of orbital motion now, yet the position of the orbit itself is unique, sharing this peculiarity with Tuttle's comet, 1858, III, alone of all the short period comets in having their aphelion points in the direction of the Vernal equinox, whereas the perihelia of the orbits of the others of this class point mostly in that same direction.

Of 25 listed in Astro-Physics November 1893, 14 have their perihelia within the two quadrants, like the major planets. Future apparitions of these comets will probably give surer

evidence of the direction of the Solar apex, through the medium of gradual changes in their orbits, than other methods now pursued.

As surmises are only children of the imagination, we set them up on temporary pedestals, called theories, until we find a solid basis to build substantial platforms.

Thus it is with reference to comets.

What are they?

They may be worlds in process of solidification, or they may become attendants or satellites to existing planets, like, for instance, Biela's double comet.

What was supposed to have been one-half of Biela's comet, was last seen in 1872 by Pogson, at Madras; its period had been $6\frac{7}{10}$ years; in 1846 it was seen as having separated into two distinct bodies, both of which were noticed in 1852.

In 1877 Prof. Hall, at Washington, discovered the two satellites of Mars. May not the two, Biela's double comet and the Martial moons, be identical?

Littrow states that in 1826, and especially in 1832, this, at that time single comet, came very near to the earth's orbit.

Is it not probable that Mars may have intercepted these two comets and placed them in servitude as satellites, by means of his attractive power?

Likewise the 5th satellite of Jupiter, discovered by Barnard in 1893, may it not be identical with some one of Jupiter's family of comets, which has since failed to report on time?

If the moons of Mars had had their existence as satellites much prior to the time of their discovery, or from the time of Mars' evolution as a planet, is it not likely that Sir William Herschel would have discovered them with his great reflector?

As to a threatened collision between a comet and the earth, as predicted by some prognosticators, no one who has ever observed the particles of dust floating in a ray of sunlight, will entertain any fear of such an imaginable catastrophe ever occurring, provided, that the movements of those atomical parts of dust are a criterion, applicable to the motion of celestial bodies, or are guided by the same laws which apply to cosmical matter distributed in the Universe.

A diligent observer of the floating of dust particles must have noticed, that they never come in contact with one another, no matter in which direction they move, some up, others down, or even if they are disturbed by a breath of air, they will commingle, but never come into collision; each particle darts away and avoids contact with others, excepting when they touch or descend to some surface, just as meteors fall upon or strike the earth.

Some scientists assert that the wandering of the perihelion, which the earth now reaches on January 1st, will so reverse the earth's orbit, that in nine thousand years hence the earth will reach that point on July 1st, or in other words, the northern hemisphere will then be nearest to the sun and the preponderance of water now covering the greater part of the southern hemisphere will be gradually drawn away from there towards the North Pole, and submerge the northern parts of Europe, Asia and America. Be this as it may, a series of contemplations presents itself here. For instance, whether a change in the relative positions of the earth and sun as now existing, will not have the effect of producing a corresponding change on the surface of our globe.

When the sun reaches that part of his orbit where the obliquity of the ecliptic will amount to 90°, the sun's North Pole will be directed towards East and the earth's North Pole towards North, consequently both are at right angles with another, the earth beginning her retrograde motion in her orbit now, 90° further in the sun's orbit, the present North Pole of the sun will be at an angle of 180° with the earth's North Pole, which continues to point North, while the sun's North Pole is directed towards the South; again 90° further the first conditions obtain again, the sun's and the earth's North Poles make an angle of 90° with each other, the sun's North Pole this time directed to the West, the earth's axis being again parallel with her orbit; her poles will also again have the sun alternately in their respective zeniths. After this the earth will have direct motion in her orbit, changing her obliquity of the ecliptic from 90° to 23½°, when the Solar system arrives once more at its present position in space.

As before stated, the moon will also vary her path about the earth, to correspond with the relative positions of the earth and sun, her mode of attraction on the waters of the earth (The Tides) must also adjust itself to existing conditions, as they arise. We perceive from the various positions of the planets and their satellites relative to the ecliptic, that they present unmistakable evidence of the probability of the earth's past and future change of orbit, inclination of axis and the consequent variation in the exterior aspect of our globe, in the distribution of land and water, climatic effects and corresponding evolution of the flora and fauna of land and water.

The inference to be drawn from the aforegoing would therefore be, that land now invisible in the southern hemisphere will eventually emerge from the ocean, and land now inhabited and studded with villages, towns and cities in the northern hemisphere will be engulfed by the encroaching waters. That such a destructive event must have actually occurred in prehistoric times, is evidenced by one of the most remote

islands of the Pacific Ocean, Easter Island, discovered in 1687, is 2,000 miles from the coast of Chili and over 1,000 miles from the nearest land, the Gambier Islands; the first discoverers, as well as all succeeding visitors, were astonished at the gigantic stone figures, scattered all over the island, which does not contain more than 30 to 40 square miles.

More than five hundred of these busts, partly in ruins, have been found, some must have been removed to considerable distances from the still existing quarries where they were cut; one hundred and thirteen vast platforms of stone, still well preserved, were found, upon one of which fifteen of these immense images had been placed. Their sizes vary from 3 to 70 feet high, head and face well sculptured, they measure the largest 14½ feet across the back, and are 6 feet thick.

The removal of and placing these colossi in position, implies that the people who erected them were possessed of considerable engineering abilities.

Mr. Mott, in a presidential address before a literary society of Liverpool in 1873, (see Science Monthly, Nov. 1876), remarks in reference to this wonderful island, "that the existence of such vast works implies a large population, abundance of food and an established government."

Yet how could these co-exist in a mere speck of land wholly cut off from the rest of the world?

Besides these, very similar remains are said to exist in other islands of the Pacific.

Do not these facts lead to the presumption that these islands are only the remnants left to testify of the former presence of a vast continent, with a semi-civilized population on this part of the earth? Is it not probable, that in remote future ages our populous northern cities with all their untold wealth of civilized art and learning, may share the fate of this Atlantis of the Pacific?

Leaving the region of paradisical climate, we are led to the domain of snow and ice by an article in the Baltimore Every Saturday Review, where it reads: "In the frozen solitudes of Alaska, Prof. Alfred Eldridge made the discovery, already noted, of the ruins of a prehistoric city 400 miles up the Kuwalik River from its mouth in Kotzebue Sound. The city was great and prosperous in the days when the North Pole enjoyed a warm climate."

Now this is remarkable news, particularly after having read the following lines, as published in various papers: "During the past eight or ten years explorers in Alaska noticed a wonderful mirage of some unknown city mirrored against the northern sky, visible however only at certain seasons."

In connection with the above we again quote from the Baltimore Every Saturday Review.

"Who knows, but some spot, once the theatre of busy and advanced human life, may have escaped the general cataclysmal wreck, and that this city may be the silent and as yet undiscovered witness of pre-polar time, standing alone in the dead desolation, in the rigid shroud of now polar death! If we must be barred from entering this undiscovered country, we may add to our equipment by a careful noting of its mirage, and then give to the bases of these phenomena a most thorough study."

Now if this discovery of the mirrored city be really based on facts, it is remarkably strange that America alone can boast of possessing the remains of a pre-historic city in arctic regions.

Ruins of ancient grandeur and splendor, monuments of man's ingenuity in times past, were heretofore only found within the tropics, in Asia, Egypt and South and Central America.

SUPPLEMENTARY DESCRIPTION OF DIAGRAM.

The large dotted circle represents the Galaxy or Milky Way, the North pole of the heavens, with the Little Bear and Polaris uppermost. To the left is the conspicuous constellation Cygnus, the Swan, forming a regular cross in this remarkably brilliant part of the Milky Way; farther below, near the Celestial Equator, is Aquila, the Eagle, with the beautiful star Atair. Just below the North pole is Cassiopeia, very much resembling a chair. Next, to the right, is Auriga, with the bright star Capella and the three smaller ones below. Then we see the Twins, with the two stars Castor and Pollux near the line of the ecliptic. On the inner side of the Milky Way there are two remarkable clusters, separated by the ecliptic, forming part of Taurus, the Bull; the upper one is known as the Pleiades, or Seven Stars, the lower group, having the form of the letter V, contains the fiery star Aldebaran, or the Bull's Eye.

Farther below is Orion, undoubtedly the most beautiful constellation in the heavens. It is also remarkable from the fact that it is visible to all the habitable world, as the Celestial Equator passes right through its middle. A little to the right is Sirius, the largest and most brilliant of the fixed stars. Farther up, on the other side of the Milky Way, is Procyon, the Little Dog.

At the bottom of the figure, in the Milky Way, is the Southern Cross, celebrated through Humboldt's description. It is not, however, near the South pole, as might be inferred from the picture, as it must be borne in mind that the Milky Way encircles the heavens obliquely, which could not well be represented in the diagram.

The frontispiece on the cover, shows Phoebus Apollo, or Helios, the ancient Sun God, driving his chariot towards the constellations of Taurus, Gemini, Orion, etc., illustrating the direction whither our own sun is actually moving in space, which is that part of the firmament containing the most brilliant groups of stars, thus presenting the most splendid exhibition, in an equal space, which the heavens afford.

We now come to the Solar system. The intersection of the ecliptic with the equator just below the comet, where the sun now is, should be in the middle of the diagram, if space permitted it.

The centre figure is the sun, showing groups of spots, the lines across represent the ecliptic, or the earth's orbit, at various angles with the axis of the earth, thus 23½°, 45°, 90° and 0°. The sun's axis is assumed to be perpendicular to his path, while the axis of the earth is always North and South, no matter in what part of his orbit the sun may be.

The oblique line, tangent to the large circle, which represents the sun's path, is the ecliptic extended in both directions, beginning at the left between the constellations of Scorpio and Sagitarius and passing between Gemini and Taurus at the right.

On the ecliptic there are Jupiter with five moons, Mars with his two, the earth at her summer and winter solstitial points, also showing the phases of the moon during one lunation. Saturn with a ring and several of his satellites, and at the extreme right is Uranus with his four moons, the arrow pointing out the vertical motion in their respective orbits.

The inner circle surrounding the disk of the sun is divided into (four) quadrants. The centre is V, Vernal Equinox, around which point all the lines revolve as on a pivot, the arrows pointing out the direction of the earth's orbital motion. Thus at D 23½ the earth's present movement is indicated corresponding with the line of the ecliptic above. D stands for direct and R for retrograde motion of the earth.

The next line from the sun to D o, shows where the obliquity will be naught and the earth's orbit parallel with the celestial equator. The next position represents the sun advanced in his orbit to where the obliquity of the ecliptic will have again increased to 45°, corresponding to the line D 45.

In this position the earth would be subject to serious climatic changes. The Torrid Zone would extend 45° on both sides of the equator, and the Frigid from 45° to the Poles, consequently there would be no temperate zones at all.

The next station shows where the obliquity has reached D 90°. The figure presents the earth in three different positions, one with the South Pole, one with the Equator and one with the North Pole exposed to the direct rays of the sun; the axis of the earth will then be parallel with her orbit.

The Poles of the earth then will alternately represent the Torrid, the Temperate and the Frigid Zones; when either Pole has the sun in its zenith, the other half of the earth, from the Equator to the opposite Pole, would, for a time, be in darkness; the moon, also influenced by the sun, encircling the earth in every conceivable direction.

Thus far the motion of the earth in her orbit has been *direct*. Henceforth it will be retrograde, as the next figure shows, which corresponds with R 23½, in reverse order to D 23½. The next is R o, where there is again no obliquity, and the days and nights are equal on the earth. The next figure shows the obliquity increased again 45°, as the connecting line shows.

Apparently this about represents the position of the planet Neptune, as indicated by his satellite.

Next we have the earth in her 90° R, obliquity orbit again, differing from the one opposite, D 9°, in that the earth now crosses the sun's disk from D 90 to R 90, whereas in the other position the motion was from R 90 toward D 90.

One or the other of these positions would illustrate the vertical and retrograde movements of the satellites of Uranus.

After this the motion of the earth becomes direct again, as it is at present.

The Tides.

The oscillations of the waters of the ocean, which cause their regular flow back and forth through the estuaries that indent the coasts of Continents and Islands, are called the Tides, which, as one of the grand awe inspiring exhibitions of nature, is familiar to all who have ever visited the seashore.

Ancient philosophers had vainly attempted to discover the cause of this phenomenon, though it is said that they had some knowledge of the moon's connection with the same. It is a problem upon the solution of which much learned ingenuity has been spent.

A great astronomer, a few centuries ago, entertained the ridiculous belief that the earth was a living animal, and the flux and reflux of the sea was the effect of its respiration.

Des Cartes, the soldier and philosopher, it appears, first discovered the regular coincidence between the motion of the moon and the tides, but his theory was, that the moon, in passing over us, exerted a pressure on the atmosphere, which in its turn forced the water to subside.

This explanation failed, as it could not account for the tide diametrically opposite the moon on the other side of the earth. However, Des Cartes' idea opened a new path for more successful research by future philosophers.

Newton's system, which has since been adopted by the entire scientific world, was announced in 1687, yet his ideas on the subject did not explain all of the natural phenomena, consequently men with more or less intelligence have ever since made efforts to discover the true solution. Up to the present time, however, no theory has been proposed which has been sustained by really satisfying evidence, and there is still much difference of opinion on the subject.

In 1738 the Royal Academy of Sciences at Paris made this problem the subject of a prize dissertation. Daniel Bernoulli, Leonard Euler, Mr. MacLaurin and Father Cavalleri, S. J., were the successful contestants. The first three named, pursued the path already pointed out by Newton, with much acuteness, whereas Cavalleri attempted the solution with the aid of the so-called Cartesian whirlpools, which obsolete

theory the Paris Academy had been sustaining for years, even after Newton's revelation of the Universality of Gravitation, which infallibly proved the nullity of Des Cartes' vortices.

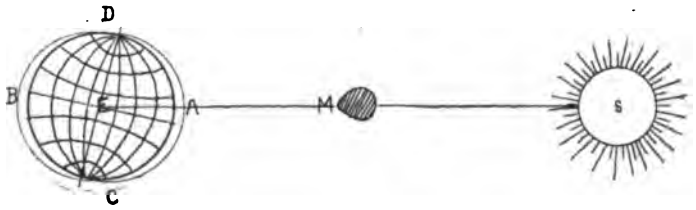
Euler says in a letter of the 14th of October, 1760, after fully elucidating his hypothesis: "The happy explanation of this phenomenon, which had so dreadfully perplexed the ancients, is a complete confirmation of the system of attraction, or of Universal Gravitation, on which is founded the motion of all the heavenly bodies."

To La Place, the eminent mathematician, we are indebted principally for the complete analysis of the theory of the tides, as accepted generally up to the present time.

He pronounces it one of the most difficult problems in the whole range of celestial mechanics. And yet there are many who doubt that the philosophy of the tides is fully understood to this day. Text books on Astronomy, of the latest issue, contain nothing new on the subject, but what was known for a century past.

Sir John Herschel, in his Treatise on Astronomy, very pertly says: "The tides are a subject on which many persons find a strange difficulty of conception. That the moon, by her attraction, should heap up the waters of the ocean under her, seems to most persons very natural. That the same cause should at the same time heap them up on the opposite side of the earth, seems to many *palpably absurd*. Yet nothing is more true." And continues in a marginal note: "It is hoped that recent (i. e., at least 50 years ago) investigations will not only throw theoretical light on the very obscure subject of the tides, but will also arouse the attention of observers, etc."

A text book on Natural Philosophy tells us, that the influence of the sun and moon is of course the strongest on that portion of the earth which is nearest to them, and the water is accordingly elevated at A, (see figure), drawn thither from



D and C, the water is also raised at B, and this is caused by the *entire solid matter of the earth* being drawn from the water at B, thus producing the same effect as if it had been raised by the direct action of the moon and sun.

An article in D. M. Warren's Physical Geography, on Tides, states, that if it be high water on the coast of Tasmania at 11 A. M., the tidal wave will reach New Foundland at

11 A. M. next day, or in 24 hours from its starting time. Now, according to the theory prevailing at the present period, a second wave must start at 11 P. M. from Tasmania, and this would reach New Foundland at 11 P. M. next day. Now, if all tidal waves would start from Tasmania every 12 hours and travel to New Foundland in 24 hours, what becomes of all the waters transferred there, and where would Tasmania get its necessary supply from? As it takes a whole day to get there, it would take two whole days to return, for the trip from Tasmania to New Foundland is accelerated by the guidance of the moon and the rotation of the earth, whereas if the wave took the direct route back, it would be arrested in its progress by opposite winds, the outcoming tidal waves and retarded by the earth's rotation.

These remarks equally apply to an article by Vaughan Cornish, M. Sc. in Knowledge, published in the Washington Sentinel June 6th, 1896. He likewise says, that "when the moon is on the opposite side of the earth, the solid globe is pulled away from the waters, leaving them heaped up, so that the result is much the same as when the moon is overhead. The tide wave, of which the crest may round the Cape of Good Hope at noon, reaches the Azores 12 hours later, at 4 hours still later the Channel, and at 10 A. M. the Straits of Dover; at 4 P.M. the return wave will be at Land's End again."

Now the next incoming tide billow, on its way from the Cape, is due 16 hours after they first reached Land's End, which will be 4 P. M., exactly on time, there to meet the return of the first wave from Dover. Do they pass one another, or what is their modus operandi? If the waves actually meet there, a vortex must evidently be the result, but none is known to occur in that locality; but if we transfer the scene of this encounter between the tidal waves to the coast of Norway, the above description would find its verification in the Maelstrom, where at high tide the water flows North and at low tide to the South.

Ten years ago Sir William Thompson, President of the British Association, spoke of American scientific men and some of their admirable work, and said that he confidently expected that American hydrography will soon supply the data from tidal observations, by which the amount of the earth's elastic yielding to the distorting influence of sun and moon will be measured.

There are other descriptions much more detailed, but every one attributes to the moon the inconceivable power of lifting the whole earth from the waters below. But this extraordinary cyclopean feat does not apparently seem to nonplus any of their authors.

It must here be noted as a striking circumstance however, that they all fail to explain *what supports the water after the solid body of the earth is drawn away.* It is certainly a logical conclusion, that a vacuum must be the inevitable result of such uncosmical action, particularly if the popular saying has any foundation, that nature abhors a vacuum.

Viewing the theory with *the eyes of reason,* it surely must appear to an unbiassed mind that it is not only inconceivable, but also impossible. In all branches of science, learned men in the past exhausted every imaginable absurdity, before theories were made to agree with acknowledged facts, and as every partially correct theory is a footstool, through which higher levels of conception may be reached, therefore let us see whether we will be able to contribute another doctrine capable of shedding new light on this obscure subject, as Sir John Herschel fitly terms it.

Intelligence and knowledge are the source of skepticism; taking everything for granted that we are taught and read, would be shutting the door against possible future discoveries and inventions. Had Prof. Roentgen not experimented with the Crooke's tubes, the world would know nothing, thus far, of the mysterious X-rays, which have since served men of inventive genius, like Edison and Tesla, as a clew to new inventions.

Then to begin: — It is essential that we first take a view of the oceanic waters in their normal state. As may be generally known, these waters of the ocean are perpetually moving in currents, which circulate around the globe and thereby tend to regulate the stable equilibrium of the sea.

The warm waters from the tropics are carried to higher latitudes through the medium of the Gulf Stream and its Asiatic counterpart, the Kuro Siwa in a northerly direction and by the Brazilian, Mozambique and other currents towards the Antarctic Sea; whilst the Polar currents flow North and South towards the Equator, either as sub-currents or parallel with others, but often in a contrary direction. A most remarkable peculiarity must here be noted, a kind of an anomaly, and that is, between two currents flowing either in the same or in opposite directions, or between a surface and a sub-current, there is always a strata of water which does not partake of the motion of either current between which it is situated. There is one strata which creates wonder and astonishment. Its position is between the two great Equatorial currents, North and South of the Equator, and in appearance it is described as being as quiet and undisturbed like a vast surface of ice; above it is the region or zone of variable winds and calms, on both sides of which the Trade Winds are continually blowing from East to West. Although this is the section where the

axial motion of the earth would find its greatest velocity, yet *this is not imparted to this still* body of water, which, if acted upon as centrifugal force would direct, should partake of the rotary motion of the earth, and form a stream or current flowing from West to East.

Now this is the view taken by some people, even scientific, of this apparent anomaly, but it is all based on *erroneous conceptions, it is a delusion,* as the very stillness or immovability of the equatorial waters, as also the region of the calm atmosphere resting upon them, is veritable proof that the waters and the air above them at the Equator actually partake of the precise velocity of the earth's equatorial rotation from West to East.

Now these main or rotation currents continually flow from East to West, and are the cause of the tides being usually higher on the Eastern coasts of Continents, than on their Western sides. They also account for seas, gulfs or bays, to which the waters have access from the East, to have a higher level than such as are locked in on that side. For instance: The Red Sea was supposed to be 30 feet above the level of the Mediterranean, which, however, has been disproved by the building of the Suez Canal; and the Gulf of Mexico should be 20 feet higher than the Pacific, yet Humboldt states in his Cosmos, that the measurements, which appear to establish the excess of height for the waters of the Gulf of Mexico, are open to many doubts. As to the Red Sea, the form of the Straits of Bab-el-Mandeb was assigned as the cause, the waters finding an easier ingress than egress, being forced through the Straits by the Eastern current. Here is another anomaly; whereas the equatorial currents of the Atlantic and Pacific, influenced by the Trade Winds, flow all the year around in one and the same direction, currents in the Indian Ocean receive their impulse from the Monsoons, winds which blow half the year north-east and the other half south-west, so that the currents flow from Spring to Fall easterly, and the reverse, from East to West, the rest of the year.

The Gulf of Mexico is charged with the waters flowing into it through the Caribbean Sea, or rather, which are forced in by the rotation current of the Atlantic, which banks up its waters against the shores of Mexico and the United States, finding no outlet there, they make the circuit of the Gulf and, assisted by the pressure of the accumulated waters in the Gulf, which are continually being augmented by the Equatorial current, the motion of which Columbus found to be strongest in the Caribbean Sea, and impelled onward by its impetuosity, they force their way into the Atlantic Ocean, through the Bahama Channel, the grand banks there turning the water to the North, which now emerges as the celebrated

Gulf Stream, which, in obedience to the same law of nature which compels the hot air of the tropics to flow off North and South, transports its heated waters to high northern latitudes, and, what is most remarkable, in a direction contrary to that pursued by the Mississippi River. Another anomaly connected with the Gulf Stream is, that its surface is said to be oval, so that anything floating in its centre will drift off either to its right or left bank. The New Foundland banks separate the stream into two branches, one setting towards the Azores and the other flowing towards Great Britain and Norway, and thence losing itself in the Arctic Sea. The Kuro Siwa, or Japan current, acts in a similar manner, carrying its warm waters to the Arctic Ocean through Behring's Strait and to the Coast of California, to which it imparts the climate of Italy, and completing the circuit of the Northern Pacific, joins the North Equatorial current, thus encircling another Sargasso or Grassy Sea, similar to, but not so extensive as the one surrounded by the Gulf Stream in the basin of the Atlantic, where most of the abandoned wrecks, which are left adrift in the Atlantic, eventually find a rendezvous, forming a kind of ocean grave-yard for these derelicts of the Atlantic, where they gradually sink, entwined by masses of sea-weed as funeral wreaths.

A counterpart of the Gulf Stream is to be found in the South Pacific, known as the Humboldt or Peruvian current. It brings the cold waters of the Antarctic Sea to the coasts of Chili and Peru, which it follows to where the coast inclines furthest westward; here the current is suddenly deflected in the same direction and then mingles its waters with those of the South Equatorial current of the Pacific.

Tides are unknown in inland seas or lakes, and although all books on the subject agree in saying: because the quantity of water is so small, that all parts are equally attracted, the writer of this is inclined to opine, that were such lakes or seas directly connected with the ocean, so that the rotation or other currents could find access thereto, the waters therein would also rise and fall.

In the Gulf of Mexico tides, as a rule, occur but once in 24 hours.

In the Mediterranean Sea they are scarcely perceptible, probably also because, as above remarked, the Equatorial current has no access from the Eastern side; although the southern branch of the Gulf Stream continues to pour in its waters in a regular current through the Straits of Gibraltar, and the surplus waters of the Black Sea find their way through the Dardanelles into the Mediterranean, yet this sea is said to be 2 feet lower than the Atlantic, caused, as is stated, by the enormous evaporation due to the excessive heat from the hot winds of Northern Africa, the Sirocco and Simoon. Humboldt

says, however, in Cosmos, that measurements have shown no perceptible difference of level between the upper surfaces of the Atlantic and the Mediterranean.

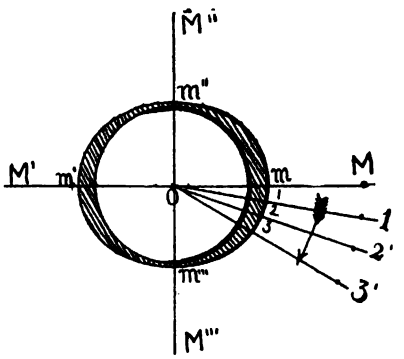
Scientists ascribe a rather startling attribute to the tides. They say, that in consequence of the retarding influence of the Tidal Wave, the velocity of the earth's rotation is diminishing and thereby lengthening the day. But whether this be so or not, there has as yet been no observational proof of the day becoming longer, and until this is obtained, we are inclined to surmise that nature is endowed with a power adequate to counteract the retarding effect of the tides on the earth's axial motion.

In fact, it must actually be so, if Newton's third law of motion can be made applicable at all. The law reads: To every action there is always opposed an equal reaction; or the mutual actions of two bodies upon each other are always equal, and in opposite directions.

Thus the various hot and cold currents of the sea flow above and below, parallel or in opposite directions with another, and if our moon was not so closely connected with our earth by bonds of nearest kinship, or if we had no moon at all, the shores along which those currents travel, would witness no variations in the regular flow of the water, the minor ones, produced either by the sun's attraction or by waves caused by winds, excepted.

But now let us place the moon in the field, immediately the aspect is changed, as ruler over the space, through which her course carries her, the waters of the sea begin to obey her command; she manifests her power by compelling them to rise in her presence, and after she has passed out of view, they resume their normal condition, i. e., they subside.

Now here is the manner in which this natural spectacle is described and explained in Newcomb and Holden's Astronomy, viz:



In the figure M is the moon on the meridian O-m of a place m. It is high water at m and m''. It is low water at m',

and m‴. In an hour the moon will have moved to 1′ and the crest of the wave to 1. The tide will be high at 1 and falling at m. As the moon moves by the diurnal motion to 2′, 3′, M‴, M′, the crest will move with it. When the moon is at M‴ it is low water at m and m′. When the moon is at M′ it is again high water at m; and so on. If we suppose M to be the sun, a similar set of solar tides will be produced every twenty-four hours. The actual tide is produced by the superposition of the solar and lunar tides.

The fundamental elements of the problem regarding the causation of the Tides, being embodied in the above, we will now proceed and submit what conclusions we have reached in reference to the Tides produced when the moon is on the opposite side of the earth, or in our Nadir; they may not prove to be overpowering convictions, but we trust that they will at least elicit new truths from established facts.

As the moon is mostly 45° in advance of high water at any given meridian, her power of attraction must therefore extend over an area of 45° radius on the surface of the earth. When she crosses a continent, say Africa, high water reaches its level on the eastern shore when the moon is 45° beyond, and as she advances in her apparent course from East to West, when within 45° degrees of the western coast a flood begins to form there. The moon's influence is there in the ascendancy and the waters flow towards her from North, South and West. Those from the East cannot follow her, excepting that which is nearest the Cape, the others returning to where they came from, there to re-establish equilibrium, or rather, as we shall see later, to meet the Equatorial or Rotation current, and jointly produce flood tide, in opposition to the one raised on the other side of the earth by the moon.

After the moon has advanced about 45° beyond the Western coast, the water is high on the African shore, and now she begins to lose sway over this part of her, for the time, temporary domain, the waters begin to fall and also to return to their source, likewise meeting some current and creating another flood, as before in opposition to the moon in the Nadir.

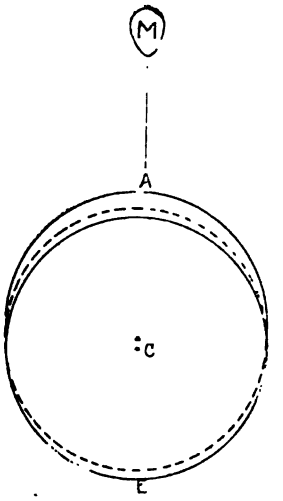
As the moon successively crosses each meridian, the tidal wave apparently follows in her wake, but this is not really so.

The moon, by virtue of the power of attraction vested in her, acts as if a brake was placed ahead of her on the waters of the sea which are moving from East to West, between the Tropics, or like the Heavens, as Columbus wrote, (*los aguas van con los cielos.* Cosmos). This supposed brake then checks and diminishes the onward flow of the currents, thereby producing low or ebb tide ahead; this is further augmented by the Rotation currents' onward flow beyond the moon's at-

tractive sphere. Hic haeret aqua. The moon then attracts the water from both her north and south sides, and backs that from the front, against those already in her rear. She is accompanied only by her van guard, and recruits her forces as she advances. The wave which seems to follow is constantly rising in front and falling in the rear, where about 45° from the moon, being released from bondage, the waters flow off in the direction prescribed by the law of gravity.

The pith then of the aforegoing treatise is contained in the conjectured power of the moon to check the onward flow of the Oceanic currents, or to impede their progress, within range of the moon's attractive power, which is, as before stated 45° in all directions from her station, and also the formation of flood tides on the side of the earth away from the moon, as a result of the brake being applied to the currents of the sea.

Here is a sketch intended to represent the moon lifting the earth from its base; if the moon is capable of accomplish-



ing such an incredible feat, she certainly ought to be possessed of the power to check the onward flow of the Equatorial current.

The proof of a theory is indisputable, if its predictions correspond with well known facts.

Now we will test this hypothesis and ascertain whether it is lame or can stand in the light of facts.

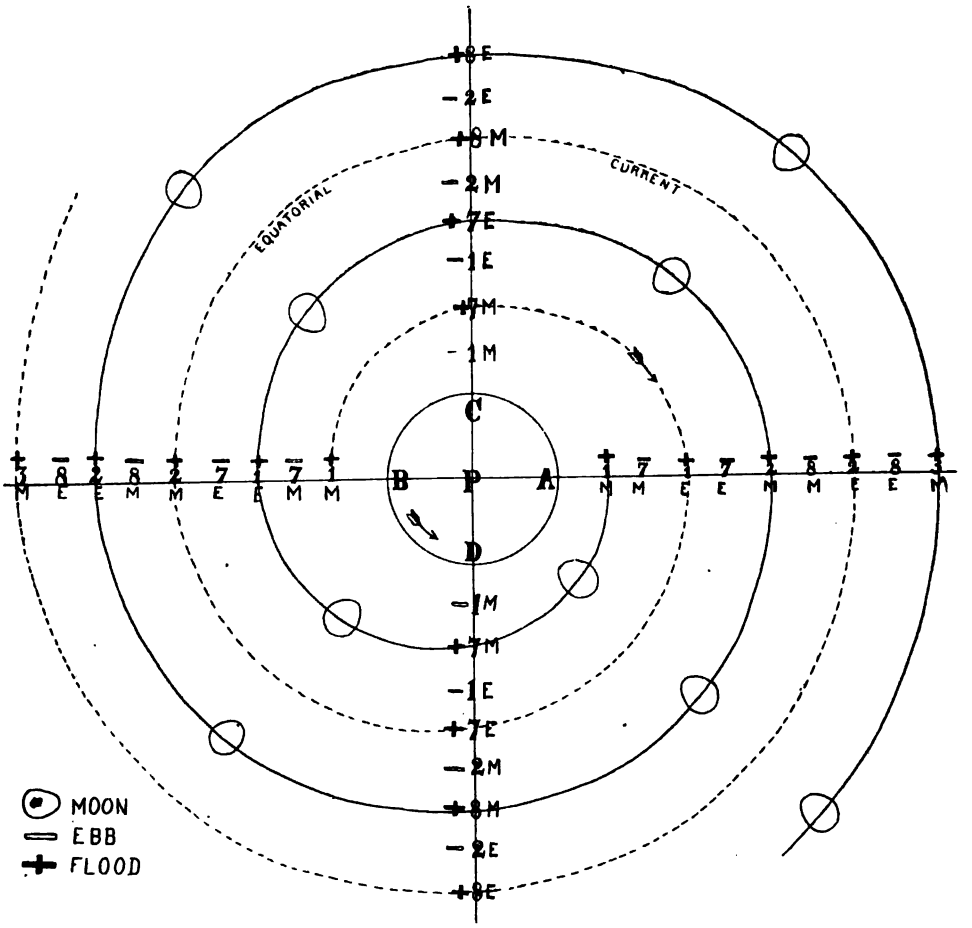
To this end, and in order to be able to elucidate the explanation more fully, we refer to the annexed diagram, viz.

A, B, C and D are four different stations on the earth, say near the equator. Before proceeding, we must explain, that for convenience sake and to make the matter more easily to comprehend, we have set the hours at all four places alike,

and placed the intervals between Ebb and Flood at even six hours.

At A and B it is 1 o'clock morning, both places are diametrically opposite each other, at both places it is high tide or flood. At C and D, also opposite each other, it is likewise 1 o'clock morning, but here it is ebb or low tide.

Now A 1 m. flood, is our starting point, the moon being 45° ahead. In accordance with what has been stated it is ebb at 1 m. D, the non-restricted equatorial current having taken the waters to 1 m. B and there produced high water in opposition to the flood raised by the moon at A, but the elevation of the water at B will be lower than at A. In



the mean time the rotation current flowed on to C 7 m. and there again raised the tide, whilst the moon simultaneously advanced on the other side of the globe and also caused high water at D 7 m. At 7 m. B it is ebb, the moon, by holding back part of the equatorial current while the unchecked part flowed onward to C 7 m., as above stated, being the cause. The moon advances, at 1 e. B, it is high water; at

A 7 m. the tide also was low, but here comes the equatorial current, which left C 7 m. and creates a flood again at 1 e. A, but lower than at 1 e. B, the unrestrained part of the current continues and fills up the gap at D 7 e. whilst the moon does the same at C 7 e. The moon then, after advancing 90°, produces another flood at A 2 m., being one hour later than on the previous day, and so on, adding an hour for each successive day.

It is scarcely necessary to mention here, that the real time of high water at any port or harbor is derived from actual observations, and the difference once found between the culmination of the moon and the actual time of high tide, will ever remain the same for each separate station, at least as long as the existing regulations regarding celestial mechanics, as far as they apply to our Solar system, remain in statu quo and in harmony with the Cosmos, or the order that reigns in the universe.

If this explanation, based on empirical concept, does not perfectly agree with the facts as observed, but merely in an approximate way, it may become the guide-post to new and more satisfactory theories, also an incentive to discover the truth and thus admit sunlight into this hitherto dark abyss.

As the Tides are subject to many interferences, as winds, deep or shallow water, shores, narrow inlets, etc., it is next to impossible to reduce the system to distinct and intelligible laws.

The successful genius who should accomplish this acme of intellectual tasks, would become renowned as a second Oedipus, the conqueror of the fabulous Sphinx.

It is not only possible, but highly probable, that the views contained in the foregoing lines, will be considered erratical at first sight, but it is an historical fact that many new ideas on various scientific subjects were heretofore condemned as illogical, until later on, the clouds, which at first obscured them, were gradually dispelled by the light of further research; we cite as one of the most illustrative examples of with what tenacity the human mind will adhere to old time notions and prejudices, the imprisonment of Galileo, by the tribunal of inquisition, for promulgating the Copernican doctrine. Another case of more recent date is that of Dr. Thomas Young, the true founder of the undulatory hypothesis of light, whose work on this subject lay buried and forgotten in the folios of the Royal Society of Great

Britain, until a new generation gradually made the same discoveries and proved the truth of his demonstrations; this theory, however, had been previously suggested by Euler, Huygens and also by Fresnel.

To conclude this rather lengthy discourse, we know of no words more appropriate than the following quotation from Humboldt's Cosmos: "In the rapid advance of all branches of physical science, much that is deficient in this attempt will perhaps at no remote period be corrected and rendered more perfect."

CONSUMMATUM EST.